

BOOK REVIEW

Plants in Changing Environments. Linking Physiological, Population and Community Ecology by F. A. Bazzaz. 1996. ix + 320 pp. ISBN 0-521-39190-3 \$74.95 (cloth). ISBN 0-521-39843-6 \$29.95 (paper). Cambridge University Press, New York.

One of the major limitations of contemporary ecology is that large amounts of data have been accumulated on a wide variety of systems, but synthesizing approaches have rarely been taken. *Plants in Changing Environments* illustrates one direction from which a synthesis might come, namely the rapprochement between autecology and synecology. In this new book, Fakhri A. Bazzaz uses succession as an integrating theme, beginning with environmental variation and physiological characteristics of plants and searching for connections to the population and community levels. Bazzaz's study is focused through his nearly thirty years of research on old field succession in Illinois, forest disturbance in the northeastern US, forest succession in the tropics, and effects of global change. The text is loosely structured by temporal and spatial scale, working from smaller, shorter scales and events in ecological time toward larger scales and events in evolutionary and successional time.

About two-thirds of the book looks at early- to mid-successional systems, primarily in Illinois. The emphasis is on about a dozen species of annuals and herbaceous perennials, many aspects of whose biology have been studied by Bazzaz and his colleagues. Spatial scales range from individual leaves or roots to patches or entire old fields; temporal scales span instantaneous physiological measurements to a few years. Although some descriptive data on changes in community composition are included in this section, this is background information. The primary themes are the major environmental factors to which the plants are exposed, and proximate responses (e.g., growth, water balance, germination) to these factors. Next, the focus shifts to plant-plant interactions, both competitive and facilitative, and explanations of population turnover in terms of these interactions. I found one of the most interesting themes in this section to be the intricate set of connections among plant architecture, environment (especially as influenced by neighbors), and competition.

The next group of chapters shifts to a longer time scale, looking at the earlier ideas from the evolutionary perspective of niche evolution in early-successional species. An important point made in this section is that early-successional species are exposed to wider environmental variation, both spatial and temporal, than are late-successional species. One would predict early species to have broader niches and greater tolerance of environmental variation; Bazzaz presents some data that support this hypothesis.

Next, the temporal framework shifts to examine the implications of autecological variation among species over successional time. Comparisons of early- and late-successional species show many significant differences in carbon and water economy, growth rates and patterns, and germination. One chapter attempts to predict community species composition from autecological data. This attempt is largely successful, although limited in scope. From data on germination requirements of a number of annuals, Bazzaz was able to successfully predict the dominant in multi-species mixtures over a range of environmental conditions.

The book ends with two chapters that extend the themes of the earlier sections beyond the early-successional venue. The penultimate chapter focuses on disturbances and regeneration in forests. The primary study organisms are species of the genera *Acer* and *Betula*, allowing comparison of gap-adapted versus understorey-adapted woody plants. Many of the autecological differences between early- and late-successional species in old field succession crop up again in these comparisons. A chapter on global change as a macro-successional process ends the book. Bazzaz suggests that human-induced changes in atmospheric CO₂, climate, and disturbance frequency will increase landscape dominance by plants with the broad niches and opportunistic dispersal and germination typical of early-successional species.

The focus throughout the book is strongly on systems studied by the author, his students, and collaborators. Of the ca. 670 references cited, about 20% include Bazzaz as an author, a remarkably high figure for a book-length work. This is a tribute to the immense energy and persistence of Bazzaz and his colleagues, whose studies range from physiological ecology and population genetics to global change. Concentration on the work of one research group constitutes both a strength and a weakness of the book. It is a strength because the author has enormous amounts of data on many aspects of the autecology and population biology

of his study organisms. This allows a synthetic viewpoint to be taken, and appropriate interspecific comparisons to be made. I found some of the most interesting passages to be the sorts of comparisons that would not be made in shorter, more tightly focused works. However, I found myself frequently wishing for a broader take on how the studies of Bazzaz and his group relate to the work of other researchers. Many references to studies by others are cited, but only rarely are detailed comparisons made.

The illustrations, although abundant (averaging about one figure per two pages) and generally helpful, sometimes seem to have been chosen for their iconic value rather than their information content. Several figures give information that is not used in the text (e.g., Figure 2.4, which gives an elaborate set of definitions of reproductive allocation and effort, none of which are referred to in the text), while others lack important orienting information (e.g., Figure 5.14, which uses various shading patterns to indicate degree of resistance to tree invasion, but lacks a key to indicate which patterns indicate which degree of invasiveness).

In conclusion, *Plants in Changing Environments* provides a wealth of information that is ripe for comparison to species of other geographic regions. I recommend it to succession researchers and, more generally, to those interested in the strengthening of synthetic viewpoints in ecology.

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